HSE (Health, Safety and Environment) culture assessment via HSEMS (Health, Safety and Environmental Management System) (Case study in Arvandan Oil and Gas Company)

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Abstract: Nowadays it's believed that most of the accidents in industries are due to inconsideration and mistakes made by worker rather than errors in equipment and machines. So it seems that implanting an appropriate HSE culture would be a useful step toward a decrease in workplace accidents. Obviously developing an HSE culture first corrects individual behaviors then decreases human errors. Although implantation of an HSE culture deals with a number of factors, based on the results of the current study, management is the key factor. In fact values, incentives and behavioral patterns that show commitment to work methods and abilities of an HSE culture, are the main material which build the HSE culture. This study mainly discusses HSE cultures including commitment, leadership, policy, strategic objectives, organization, documentation, resources, risk assessment and management, planning, stability and revision and auditing. In this study, 175 employees of Arvandan Oil and Gas Company were chosen by Morgan table out of 320 employees then the questionnaires were distributed among them. Reliability and perpetuity of the questionnaire was calculated through Cronbach's alpha (0.971). Data from the questionnaire was transferred to data bank and statistical analyses were conducted by SPSS19 software. The desirability of the HSE culture was classified in a 5-point range using Likert's scale, ranging from "completely desirable" to "completely undesirable". Results of T and Friedman test showed that cultural elements of HSE are in a desirable level in Arvandan Oil and Gas Company.

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1-Introduction

Management system all around the world underwent great deal of change during this half century. These fundamental changes happened because of the limitations toward using natural resources and also because of the great cost of human resources, so that organizations tried to not only a responsible for their owner's profits but also gain a good situation in this competitive world of now. Traditional methods for increasing the efficiency concentrate on increasing production, profit and the result. In those methods the basis for production was the predictions on the market according to the current state of the market. These predictions always are accompanied by an inevitable error. Additionally, depreciation in equipment and machines affects production. So, big industries, which have a long life and different risks, are complicated to change (in their production technology) because of high fixed starting costs. On the other hand, after a while these equipment start to increase wastage and error risk. So regarding the human resources which is the inevitable part in dangers, to operate new equipment safety actions should be taken so that if managerial views changes risks could be lowered anyway.

2-Literature review

Safety has been defined differently by organizations and individuals. HSE culture was first used by International Nuclear safety Advisory Group in 1986 in IAEA's report on Chernobyl's incident. International Nuclear safety Advisory Group stated that "the term HSE culture refers to general topics, individual sacrifices and responsibility of all the people involved in any action affecting the safety in an atomic site".

Atomic Sites Monitoring Committee defines HSE culture as: "HSE culture is a direct result of values, views, perceptions, qualifications and group or individual behavioral samples that show commitment

to HSE and makes the manners and safety management's efficiency in an organization.

Cooper 2005 defined HSE culture as a result of objective interaction between individuals, tasks and organizations and a level of effort in which all the individuals try to improve safety[4].

In their researches, Cox, Lee, and Wilpert stated that HSE culture is the result of values, views, perceptions, efforts and behavioral patterns of those whose manners and commitment to health defines organizational health[10].

Also a number of scientists defined HSE culture as a collection of ideas, norms, views, roles and professional and social customs which are made of the efforts individuals do to prevent danger[13].

Richer et al defined it as "definition of experiences and interpretation of learning from work and safety which guides individual acts in the case of danger[19].

Regarding different definitions of HSE culture Wigman et al defined it this way: "HSE culture is the value or preference given to safety in any level and by any individual". HSE culture refers to the area in which individuals or groups commit to safety issues, efforts for continuous learning, consistency and correction and also learning form mistakes. Any organization trying to have a perfect HSE system should first implant an HSE culture which means safety should be a part of action from the designing phase until the end. Safety must be a routine. It could only happen if management truly believes in the importance of HSE and acts on the basis of this belief[21].

3. Studying views on HSE

3-1- Descriptive models

In this models viewer only observes the behavior and doesn't judge them. Description could be quality type (case study) or quantity type (statistical analyses). [1]

3-2- Prediction models

These models study the cause and effect relationships in organizations. In these models, different mathematical or statistical models are used which causes a better perception of the researcher about the cause and effect relationships. Generally not only prediction models aren't ahead of descriptive ones but also their made of descriptive models because first a good interpretation of what happened must occur then the causes can be identified. Since calculating all the variables affecting a behavior is hard, efficient prediction models are hard to find. Prediction models are usually resulted from repetitive observation but due to the unique properties of organizations are doubtful. An example of prediction models is Hathron's model. In this study the main purpose was to find the cause and effect relationship between manners and efficiency[5]. They didn't find any result, in other words there was no relationship between manners and efficiency. Another problem with prediction models is that they seem unrealistic. For example take analyzing the effects of cash benefits on the HSE culture; if only employees' daily life is considered then the perfect relationship could not be found, because other organizational and individual factors affect this relationship. Additionally creating such a model requires observing the effects of all the variables. To overcome this problem some certain situations should be specified. So if the benefits are doubled or cut behaviors may change. But in real workplaces it's hard to change the benefits on a short term run just to change the safety behaviors.

3-3-Prescriptive models

These models (AKA normal models) prescribe a situation as the best situation and a behavior as the best behavior. In other words in a certain situation, prescriptive models tell the individual what to do. While the human relation theses say in which class to put the individual on the basis of what he/she does. Good prescriptive models come after the results of prediction and descriptive models. Prescriptive statements have a d good knowledge about the cause and effect relationships in any system.

Different prescriptive models

1. Cox model

Cox et al 1997 developed their model. In this model, organizational variables like management, policy, and HSE objectives affect environment and work procedures like danger assessment and this finally affects behaviors like responsibility. According to this model, managers and their actions are the main cause of any change in system.

2. Cooper model

In 2000 cooper developed a model which was similar to Geller's and its foundation was the 2-way certainty model by Albert and Androa. Regarding this model there is an interaction between mental, environmental and behavioral factors of HSE culture.

According to this model, organizational culture results from interactions between individuals (mental factor), tasks (behavioral factor) and organization (environmental factor). This model implies that individuals are affected forcibly by the environment and there is mutual effect between them. According to this model HSE culture could be assessed by questionnaire, just like behaviors can be assessed by behavior check lists and environment through monitoring and revision[2].

3. HSE culture's ladder model

The best way to understand an HSE culture is culture' ladder. Each step consists of unique properties

which is direction of last step. This ladder is like a map showing the situation form the HSE culture aspect and shows where the next step is headed. The 5 steps are as below:[6]

- Pathological
- Reactive
- Calculative
- Proactive
- Generative

1. Pathological: in this level no attention is paid to health, safety and environment and only rules are followed. HSE culture is not understood properly.
2. Reactive: in this level HSE culture is taken seriously but only in the time of danger. People say stuff like "it's dangers career, be careful" or "people who have the accident are the ones who were responsible for it".[8]
3. Calculative: organization has a system. The HSEMS is implanted successfully and HSE is taken seriously and the concentration is on numbers and statistics. Data are collected and analyzed and monitored. In this level there still are some casualties which make everyone surprised.[5,14]
4. Proactive: in this level previous incidents aren't the bases for decision. Not only previous accidents are prevented but also probable accidents in future are in the center of attention. In this level people are actually involved in HSE. People working in HSE are decreased and their only role is consulting. When the organization climbs the ladder trust and understanding is increased and people are more responsible.
5.Generative: generative organizations are of high standard organizations and try to act beyond the rules and regulations. These organizations have an honest act towards deficiency and use it for improvement not to blame. They don't expect prefect work they need better work. Management knows that employees trust it and are in touch with it[11].

4-HSEMS

In each system the thoughts determine the intervals after which a system will achieve the objectives. International companies found their experiences and background in HSE as the main factor in controlling dangers in the industries[20,18].

1. HSE is a part of management system in any organization which like any other system consists of planning, execution, controlling and correction. There are inputs like equipment, material, money, time, labor and facilities… processes like strategic planning, guiding and leading, managing, recognition and determining, analyzing and assessing, improving the behaviors… and they all lead to some outputs. But the output could be damage or danger if the system is not designed properly.

In 1974, OGP was established by companies cooperating in oil production and their members were introduced in the UN and EU[16].

Adding EMS to OHS and SMS, these two which only covered safety and health were completed and covered HSE.

OGP guidelines introduced some elements for HSE to implant and maintain this system. HSEMS consists of 7 elements[15]. Table (1) is shown in end of article.

1- Leadership and commitment

Senior management makes sure that the objectives are achieved through providing the resources needed for HSEMS. Management should make sure the necessity of HSE in understood for everybody and the actions are supported.

HSEMS must be supported according to the items below:

- Believing that the company wants to improve HSE
- Motivating the staff to improve their HSE actions
- Responsibility towards HSE
- All levels are involved in developing HSEMS
- Committing to an effective system in HSEMS[6]

2- Policy and strategic objectives

Management must define and document the objectives and policies. And make the followings happen:

- Consistency with the main company
- Consistency with productions and their effects on services and goods
- Consistency with other policies
- Having the same value as other objectives and policies
- Committing to rules and regulations
- If there no standard, setting a rational standard and applying it
- Committing to lower the risk involving in HSE to a minimum
- Committing to efforts that improve HSE performance

3- Organization, resources and documentation

This item contains the followings:

3-1-organizational structure and responsibilities:

Execution and performing a successful HSE program is amongst the responsibilities of organizations and all levels of management and leadership must get involved in it. This must be considered while designing the structure and allocation of the resources. To successfully implant HSE plans, organizational chart must contain all

responsibilities, tasks, authorities, and communications including:

- Providing labor and resources needed for HSEMS
- Making sure that every plan is consistent with HSE policy before even starting the plan'
- Gathering information about HSE topics and interpreting them
- Recognizing and recording corrective steps and improvement opportunities

3-2- resources

Senior management must make sure that there are adequate resources in order to achieve HSEMS goals. Resource allocation needs to be revised periodically.

3-3 documents

Following documents have got to be provided and controlled by the company:

- Policy, objectives and plan for HSE
- Determining and recording the responsibilities
- Explaining the HSEMS's elements and their interactions
- Connecting and explaining other documents related to the HSEMS
- Recording the results of risk and HSE assessment
- Developing ground rules related to HSE
- Procedures must be developed for special key actions
- Explaining reaction plans and responses in the cases of potential danger

4- Risk management and assessment

There is some risk in any human action. This section is devoted to:

Recognizing HSE risks and assessing them for every action, service or production and also developing risk lowering steps. Company must have practical methods to systematically identify risks and their effects and equipment needed in risks. Identification range must cover all actions from the beginning. Danger recognition must include the followings:

- In designing, building and developing stages (capital, activity improvement)
- In the normal and abnormal situations which involve emergency stops, repairing, and maintenance
- Potential incidents and situations which follow the following:
- Sabotaging the monitoring system
- Human factors including: destruction in HSEMS
- Potential risks and effects of theirs[9]

5- Planning and operation control

- This section is devoted to posture of planning the activities related to risk lowering (through assessment and management of risks). This part consists of programming for the new and current activities and managing the changes and developments needed to confront new situations. Company should embody HSE objectives in long-term programs. These programs include:
- Clarifying the objectives
- Clarifying the responsibilities in order to achieve the objectives in every level
- Incentive plans and motivating the staff to learn about HSE culture
- Processes in order to recognize good individual and group activities related to HSE
- Assessment and pursuit mechanisms[8]

6- Execution and perpetuity

This section explains about how the activities should be executed and continued. Tasks and activities must be clear before planning step. These activities in every level are as following

- Improving guideline objectives and planning senior section's activities ni accordance with HSE policies
- Providing and constituting procedures must be done by management and leadership

Management must be responsible for developing and approving tasks in accordance with procedures. Also management must make sure that controlling limitations aren't violated. Stabilizing the processes, management must guarantee the adequacy of HSE actions

7- Verification and revision

1-7 Verification

First the areas in need of verification should be recognized. Verification must include HSEMS and its range of action and its accordance with other executive actions. Verification must become a part of normal monitoring, so organization must consider the followings:

- Labor necessities and the properties of a verification team
- Monitors mustn't be involved in monitored actions in order to have a fair judgment
- The documentation and monitoring methods which could include using questionnaires, check lists, interviews or direct observance
- Accordance or non-accordance of HSEMS elements with necessities defined
- HSEMS's effectiveness in achieving executive norms

2-7 Revision

Senior management must revise the HSEMS regularly in order to make sure that its plans are still

effective. Revision must include the following but shouldn't be limited to these:

- Probable needs to change in policy and objectives and situations and permanent commitment to them
- Allocation of resources in order to implant and maintain HSEMS
- Places and sites according to risk assessment to confront emergencies[14]

5-Methodology

Form objective aspect this study can be categorized as: historical, descriptive and experimental. Also by its very nature it is: fundamental, theoretical and practical. As current study tries to improve practical knowledge in a certain area (organizational performance and happiness), in other words it's practical, this study is a practical type, and it's a descriptive type considering data gathering method and in descriptive type it can be categorized as padding because the main objective is to understand the best work situation in order to gain competitive advantages.

5-1-Hypotheses:

1) Commitment and leadership and HSE culture are in a good level in this organization
2) Policy and strategic objectives in HSE system are in a good level
3) Resource allocation and documentation and HSE culture are in a good level in this organization
4) Risk management and risk assessment and HSE culture are in a good level in this organization
5) Planning and HSE culture are in a good level in this organization
6) Execution and perpetuity and HSE culture are in a good level in this organization
7) Verification and revision and HSE culture are in a good level in this organization

6-Population and sampling

Topic territory: since the HSE matter is important both in private and governmental section, this study could be used in all organizations. All the organizations that share a property are a population. The population is all the staff in Arvandan Oil and Gas Company. The locality: this study was a case study in Arvandan Oil and Gas Company. The time territory: this study was conducted in 90-91. 175 people were chosen out of 320 according to the Morgan's table so that their staff number and names were taken and 175 people were chosen randomly. Questionnaires were distributed and 160 were completed properly by staff with different college degrees. The questions were about automation system governing the organization.

7-Reliability

One of the most important properties of measurement tools is reliability. Reliability shows the stability and consistency of the concept in question and helps users to judge the measurements. Reliability implies the extent to which the measurement tool results the same in the same situation. Cronbach's alpha is the most commonly used tool to assess the reliability.

Cronbach's alpha is weak below 0.6, acceptable on 0.7 and good above 0.8. The more it's closer to 1 the better it is (Danaeefard 1383, p489-490). Cronbach's alpha for a questionnaire is calculated by SPSS software.

According to the table below the Cronbach's alpha is 0.971 which is above 0.7 so it's acceptable.

Table(2): Reliability Statistics

Cronbach's Alpha	N of Items
.971	63

8- Analysis of the data form questionnaire

To analyze the hypotheses, H0 and H1 hypotheses are used which are stated as below:

H0: the element in question is in a desirable shape in HSE culture

H1: the element in question is not in a desirable shape in HSE culture

This study is done by one-sample test and test value equals 3 which means sig Is 3 and the mean is said to be above or below 3 that shows desirability and undesirability respectively. If sig is below 0.05 and both minimum and maximum are positive, then the element in question is above 3 and it's in a desirable level. If sig is above 0.05 element in question's mean equals 3 and it's undesirable so management should try to improve it. In the table (3) in end of article the means for HSEMS elements are calculated by SPSS software.

To analyze the hypotheses through one-sample test, the means of 7 elements of HSE is compared to the number 3 in table (4) that is shown in end of article.

Analyzing hypothesis no.1

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. Then it can be concluded that the leadership and commitment are in a desirable level in Arvandan Gas and Oil Company and senior management has developed appropriate procedures consistent with commitment in every level.

Analyzing hypothesis no.2

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. Then it can be concluded that the policy and strategic objectives are in a desirable level in Arvandan Gas and Oil Company. The objectives are firstly smart and secondly consistent with each other. Also the activities are in consistency with the policy and emphasize the permanent improvement.

Analyzing hypothesis no.3

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. This hypothesis shows that resource allocation and documentation which are a part of HSE culture are in a good level in Arvandan Gas and Oil Company. It shows that responsibilities and organizational structure are properly implanted. Also management's agents are doing great in managing HSEMS to improve HSE culture.

Analyzing hypothesis no.4

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. This hypothesis shows that risk management and risk assessment are in a good level in Arvandan Gas and Oil Company which means all potential dangers are recognized and all the risks are assessed for the activities, productions and services and also development plans are conducted to lower the risks. Also after assessing the risks all the people involved and then all the organization is told about it. This element is amongst the strong points in HSE culture.

Analyzing hypothesis no.5

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. This hypothesis shows that planning in HSE culture is in a good level in Arvandan Gas and Oil Company. This element shows that the organization has taken good steps towards reacting in the cases of emergency. The staffs are well trained through taking classes and participating in maneuvers. People are committed in the situations of danger. Amongst the strong points of planning in HSE culture is real integrity in capital, so that HSE is taken into account in every step, designing, buying and installing the equipment.

Analyzing hypothesis no.6

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. This means that execution and perpetuity in HSE culture are in a good level in Arvandan Gas and Oil Company. Also correction is a part of the plan. Perpetuity is perfect in the company to make sure that plans are being continued just well. Identifying inconsistencies resulting from wrong decisions by the management or error in equipment or mistakes made by human resources, and the effort to correct them is being followed appropriately. Reports are done regularly and they are being taken care of systematically. Perpetuity of health in an organization shows that the organization cares about the human resources as the most valuable capitals.

Analyzing hypothesis no.7

As you can see in table 4, according to the sig that is below 0.05 this hypothesis is approved and this aspect is in a desirable level. Hypothesis H0 is approved. Revision and verification are in a desirable level in HSE culture meaning that periodic revision of the performance, effectiveness and consistency are in HSEMS. Procedures are regularly verified to guarantee permanent improvement.

Results and suggestions

Oil industry as the key industry in Iran (and also because of its complexity and, due to various dangers) needs a strong system which can identify and assess and control danger and also value the human resources as its main capital. In the Oil industry HSEMS is a necessity for all the Oil Companies which follows some objectives including: lowering casualties, profitability, social responsibility, and satisfactory. Achieving these objectives is impossible through classical management theories (like Taylor). It needs an organizational culture which is known as HSE culture. So it's necessary to understand and realize how important HSEMS is in improving HSE. Industrial environments, because of their very nature are in serious danger and the more technology grows the more dangers become more serious. In the year 1977, 250 million incidents happen all around the world, 350 thousand of which resulted in death. According to the reports of Universal Health Organization in 1994, 8 out of 10 labors were working in developing countries, 5-10 % of which had access to safety and health services. In that very year, 120 million incidents happened in these countries, 200 thousand of which resulting in death. In traditional safety engineering, safety in considered as preventing unsafe actions but new technologies has considered safety guards as naturally safe systems. Regarding the fact that human resources are the inseparable part of the system and also the main capital, and regarding that human resources aren't mistake free, human resources must be the focal point. Following suggestions are in direction with implanting a successful HSEMS:

- ✓ Resources must be allocated effectively in an organization (resources needed to maintain production equipment and resources needed to confront danger, verification and revision of the HSEMS, and improving new plans.
- ✓ Qualifications and competences are valued in an organization. People ought to be trained in accordance with their tasks.
- ✓ Adequate monitoring should be placed on contactors. They have to be assessed in the terms of consistency with HSE necessities in before, during and after contract.
- ✓ Communications within and beyond the organizations must be appropriate in the cases of danger
- ✓ There is enough documentation and there are documents for each and every action.

1.

Table (1): the elements of HSEMS

HSE elements	**Definition**
Leadership & commitment	Commitment in senior levels down to junior levels and proper organizational culture is the key to success
Policy & strategic objectives	Desires and would, principles and ideals regarding HSE aspects
Resource allocation & documentation	Organizing people, allocating the resources and documentation for a better HSE performance
Risk management & assessment	Identifying and assessing risk for productions, services and also steps towards improvement
Planning	Planning the steps and reactions toward emergencies
Execution & perpetuity	Execution and perpetuity and the state of correction steps
Verification a revision	Periodic verification and revision in systems performance and its effectiveness and consistency

Table (3): One-Sample Statistics for HSEMS

	N	Mean	Std. Deviation	Std. Error Mean
Commitment and leadership	160	3.2687	.83281	.06584
Policy and strategic objectives	160	3.6713	.62459	.04938
Organization, resources and documentation	160	3.3020	.64825	.05125
Assessment and risk management	159	3.4061	.80837	.06411
Planning	160	3.4896	.73864	.05839
Implementation an monitoring	160	3.7187	.63654	.05032
Review	160	3.6479	.66167	.05231

Table(4):One-Sample Test for HSEMS

	Test Value = 3					
				95% Confidence Interval of the Difference		
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Commitment and leadership	4.082	159	.000	.26875	.1387	.3988
Policy and strategic objectives	13.59	159	.000	.67125	.5737	.7688
Organization, resources and documentation	5.893	159	.000	.30200	.2008	.4032
Assessment and risk management	6.335	158	.000	.40611	.2795	.5327
Planning	8.384	159	.000	.48958	.3743	.6049
Implementation and Monitoring	14.28	159	.000	.71875	.6194	.8181
Review	12.38	159	.000	.64792	.5446	.7512

Resources

2. Taghdisi, H. Alizadeh, M.S," Integrated Management System HSE",Printing, Publishing Knowledge Poewe, 1387
3. Danai fard M, Alvani M, Azar A., (1383), "qualitative research methodology in management: a comprehensive approach," Publishing Saffar , Tehra
4. Rezaeian. ALI," Principles of Organization and Management", Thirteenth Edition, SAMT Publishing 1388
5. Sarmad Z, Bazargan A, Hejazi, A., "Research Methods in the Behavioral Sciences," Thirteenth Printing, Agah Publishing Tehran(1385)
6. Cooper MD.toward a model of safety culture. Safety science.2000:36(2):111-36
7. Correll M, Andrewartha G. meat industry survey of OHS culture.2001
8. Corvalan CF, Kjellstrom T, smith KR. Health, environment and sustainable development. Identifying links and indicators to promote action. Development.1999: 10:656-60.
9. Goldstein G, Helmer R, Fingerhut M. the WHO Global strategy on occupational health and safety. African Newsletter. 2001:11(3):56
10. Grander RL. Benchmarking organizational culture: organizational culture as a primary factor in safety performance. Professional safety. 1999:44(3):26-32
11. Guidelines for the Development and Application of Health, Safety and Environmental Management System. Report No: 6.36/210. July 1994
12. Hajji Sophocleous GV. Development of performance – based codes, performance criteria and fire safety engineering methods. International journal on engineering performance – based fire codes. 2001:2(4):127-42
13. Monnery N. the costs of accident and work related ill-health to cheque clearing department of financial services organization safety science. 1998: 31(1):59-69
14. Neto ASV, BarrosoACO.GoncalvesA.knoledege basis in safety culture for researchers and practitioners.
15. Probst. TM, srtarda AX. Accident under reporting among employees: testing the moderating influence of psychological safety climate and supervisor enforcement of safety practices. Accident analysis and prevention. 2010:42(5):1438-44.
16. Reason J. Achieving safe culture: theory and practice. Work and stress. 1998: 12: 293-306
17. Reason JT. Managing the risk of organizational accident 1997.
18. statistical of yearbook of the social security organization of Iran. 1383
19. statistical of yearbook of the social security organization of Iran. 1388
20. Wilpert B. organizational factors in nuclear safety. Frontiers science series.2000:2:1251-68.
21. Wiengman DA, VON Haden TL, Gibbons AM.A review of safety culture theory and its positional application to traffic safety. Improving traffic safety culture in United States: 2007:113.
22. Wiegmann DA. Zhang H, VON thaden T, Sharma, G Mitchell A.A synthesis of safety culture and safety climate research. Disponible en http://www.humanfactors uiucedu/reports and papers pdfs/techreport/02-03 pdf accessed Sep 16.

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